The following communication was also read:—

II. "Discussion of the observed Deviations of the Compass in several Ships, Wood-built and Iron-built; with General Tables for facilitating the examination of Compass-deviations." By G. B. Airy, Esq., F.R.S., Astronomer Royal. Received September 14, 1855.

[A paper by the author, with the above title, was read on the 21st of June, 1855; it was subsequently withdrawn for the introduction of certain alterations, and, so altered, constitutes the present communication. An abstract is given under the above date, p. 491.]

November 30, 1855.

Anniversary. A Report of this Meeting will appear in a subsequent Number.

December 6, 1855.

Sir BENJAMIN BRODIE, Bart., V.P., in the Chair.

The Chairman announced that the President had appointed the following gentlemen Vice-Presidents:—

Colonel Edward Sabine, R.A.
Rear-Admiral Beechey.
Sir Benjamin Brodie, Bart.
Charles Darwin, Esq.
Sir Philip de M. G. Egerton, Bart.
William Allen Miller, M.D.

The following communications were read :—

I. "On the Determination of the Dew-point by means of the Dry- and Wet-Bulb Thermometers." In a Letter of Lieut. NOBLE, R.N., of Toronto, to CHARLES R. WELD, Esq. Communicated by Professor STOKES, Sec. R.S. Received September 24, 1855.

Toronto, September 10th, 1855.

MY DEAR SIR,—The results of the accompanying table for computing the dew-point from readings of the dry- and wet-bulb thermometers, are, as I believe you know, derived from observations taken here during last winter by Mr. Campbell and myself:—

TABLE *for computing the Dew-point from Readings of the Dry- and Wet-Bulb Thermometers.*

Temperature of air (t).	Factor (f).	Number of observations (m).	Probable error of a single datum (r).	Measure of precision of a single datum (h).	Probable error of the adopted factor $R=\frac{r}{\sqrt{m}}$.	Measure of precision of the adopted factor $H=h\sqrt{m}$.	It is therefore an equal chance that the true factor lies between
48° to 51°	2·31	21	·30	1·590	·07	7·287	2·24 and 2·38
46 ... 47	2·38	13	·26	1·822	·07	6·569	2·31 ... 2·45
42 ... 45	2·53	41	·40	1·189	·06	7·613	2·47 ... 2·59
40 ... 41	2·63	17	·41	1·163	·10	4·796	2·53 ... 2·73
38 ... 39	2·83	25	·48	0·999	·09	4·994	2·74 ... 2·92
34 ... 37	3·02	64	·43	1·114	·05	8·912	2·97 ... 3·07
32 ... 33	3·33	25	·63	·767	·12	3·835	3·21 ... 3·45
30 ... 31	3·81	22	·61	·775	·16	3·633	3·65 ... 3·97
28 ... 29	4·40	27	·66	·723	·13	3 756	4·27 ... 4·53
24 ... 27	5·46	43	·82	·577	·13	3·787	5·33 ... 5·59
22 ... 23	6·06	15	1·20	·397	·31	1·535	5·75 ... 6·37
20 ... 21	6·93	6	1·40	·341	·57	·834	6·36 ... 7·50
18 ... 19	7·13	21	1·44	·331	·31	1·517	6·82 ... 7·44
16 ... 17	7·60	20	1·76	·271	·39	1·209	7·21 ... 7·99
14 ... 15	8·97	17	1·72	·277	·42	1·141	8·55 ... 9·39
12 ... 13	10·30	20	2·53	·188	·56	·842	9·74 ... 10·86
10 ... 11	11·50	11	2·19	·218	·66	·723	10·84 ... 12·16
8 ... 9	13·06	8	4·63	·103	1·64	·292	11·42 ... 14·70
6 ... 7	15·30	7	3·66	·130	1·38	·345	13·92 ... 16·68
0 ... 5	16·23	14	1·87	·255	·50	·955	15·73 ... 16·73
−1 ... −4	19·37	10	4·11	·116	1·30	·367	18·07 ... 20·67
−5 ... −10	21·64	6	4·65	·102	1·90	·251	19·74 ... 23·54
−11 ... −16	37·83	6	10·96	·044	4·48	·107	33·35 ... 42·31

These results will be obvious at a glance; but a few remarks upon the instruments employed, and upon the degree of reliance to be placed upon them, may not be uninteresting.

The dry- and wet-bulb thermometers (for which we were indebted to the kindness of Prof. Cherriman, Director of the Magnetic Observatory, Toronto) were made by Negretti and Zambra, and their index errors were ascertained, above 32° by Mr. Glaisher, and below 32° by ourselves, by comparison with a Kew standard. The divisions upon these thermometers were too small to read 0°·1 with great accuracy; and in discussing our observations at low temperatures, we were in consequence obliged to reject such as would, with an error of 0°·1 in the reading, introduce a considerable error into the factor.

You will observe that the table does not extend below —16°, although we have repeatedly every winter the mercury below —20°, and occasionally below —30°. The only thermometer, however, which we could trust as a wet-bulb in investigations so delicate was not graduated below —16°.

For obtaining the dew-point by direct observation, we used the condensing hygrometer invented by M. Regnault.

We obtained dew with this beautiful instrument at all temperatures (limited only by the graduation of the thermometer —35°), the only requisites when the thermometer is very low being time and pure ether*. I can testify from experience that this hygrometer obviates all the disadvantages of Daniell's, which M. Regnault enumerates in his hygrometrical researches.

In order to show the reliance that may be placed upon our results, we have put opposite each factor in the table the probable error and measure of precision of the single data (from which the factor (f) was derived), and also the probable error, measure of precision, and limits of certainty of the adopted factor. The nomenclature and notation are thus employed by Encke in his Memoir on the Method of Least Squares.

The measure of precision (h), as was indeed to have been expected, decreases with the temperature. This fact is not however of so much importance as might at first appear.

* The ether we employed below —20° was the first that passed over, resulting from the distillation of washed ether with quicklime.

For the dew-point is given by the equation,—

$$T=t-f(t-t').$$

where (T) is the temperature of the dew-point, (t) that of the air, ($t-t'$) the difference between the dry- and wet-bulb thermometers, and (f) the factor whose value is given in the table.

Now taking the temperatures 42° and 22°, it appears from the table that the probable error of (f) for a single observation is at the latter temperature three times greater than at the former. But ($t-t'$) is on an average about three times as great at 42° as at 22°. Hence the probable error of the dew-point at both temperatures is very nearly the same.

We have extended our table to 51° for the purpose of comparison with the "Greenwich factors." I must however remark, that it is probable that the factors, which we have given above 40°, are rather greater than they would have been had the observations discussed extended through a longer space of time, the majority at these temperatures having been taken last spring, when the air was very remarkably dry; and experience shows that when ($t-t'$) is unusually great, the deduced factor, instead of being more accurate, is generally much too large.

As an instance, I may cite an observation taken on April 29th, when the temperature of the air was 43°·6, that of evaporation was 31°·6, and that of the dew-point 3°·2. The fraction of saturation on this occasion was $\frac{19}{100}$, and the factor derived from this observation was 3·36; this being much the largest deviation from the adopted mean 2·53.

The cause of this discrepancy is doubtless owing to the heat that the wet-bulb thermometer derives from the radiation of surrounding objects; and were observations sufficiently numerous, it might conduce to accuracy were the factors calculated for every degree of difference in the value of ($t-t'$).

We purpose instituting a comparison between two wet-bulb thermometers placed in similar boxes, the one box coated with lamp-black, the other with a polished metallic surface.

Below 32° our results do not appear to coincide with the factors deduced from the Greenwich observations; and the causes of these discrepancies I must leave to time.

As, however, we have had considerable experience at these temperatures, I may perhaps be doing service to observers in bringing before their notice two causes of error, to which we have found ourselves particularly liable when the thermometer is near 32°.

1st. If the air is a little above, and has been below 32°, there will frequently be a small button of ice at the foot of the wet-bulb thermometer, which is not easily perceived, and which will keep it at 32° when the temperature of evaporation is really above that point.

2ndly. It is well known that under certain circumstances water may be cooled below 32° without freezing; and an example will perhaps best show the error which this fact may occasion.

Let us suppose that the temperature of the air is 27°, and that when the thermometer is wetted it sinks to 26°, and then rises. Should it rise very slowly, or not at all, the probability is that 26° is the true temperature of evaporation, but if rapidly, the rise may be due to the conversion of the water into ice; and it will be prudent to observe whether or not the thermometer again commences to sink.

We have frequently observed this phenomenon, and I am quite at a loss to what to ascribe its uncertainty.

It has occurred both in a high wind and a calm (the thermometers are protected from the full force of the wind), and it also appeared to be quite uncertain at what temperature the water might freeze.

I am obliged to admit that the limits of certainty of the factors below zero are not quite so close as could be desired. This is partly attributable to our being obliged to reject many observations made with a thermometer which was broken before its index-errors were fully ascertained; but Mr. Campbell and I must claim the indulgence of those who know the difficulty of taking observations requiring so much time and accuracy at such temperatures, and frequently at six o'clock in the morning.

Believe me, &c.,

W. Noble,
Lt. R.N.

C. R. Weld, Esq., Assist. Sec. Royal Soc.